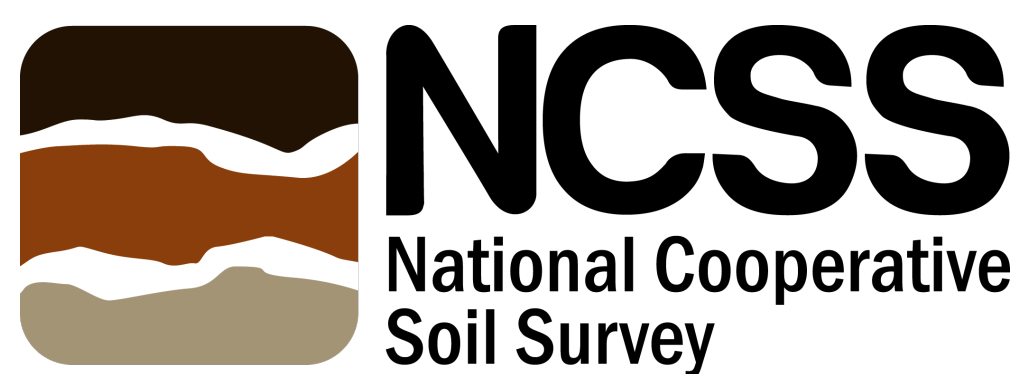# Visualizing the SSURGO Dataset

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Rational and Objective

The U.S. Soil Survey Geographic database (SSURGO) contains a vast amount of information about the soils of the United States. The objective of this project is to visualize the SSURGO database in a way that the spatial distribution of soil properties as defined and categorized in Soil Taxonomy becomes clearly visible. This will make it possible to understand relationships that may not have been apparent before.

To do so, we assign each soil map unit to a property of interest and then create multi-resolution maps of these properties to a scale of ~1:18,000 for study using Soil Explorer.

Here we summarize the procedures used to create these maps, present a completed map of Sodic Soils as an example, and present several draft maps currently under development.

Data Source and Initial Processing

The SSURGO dataset was downloaded in its entirety from the NRCS Box site (https://nrcs.app.box.com/v/soils). The full dataset for the area covered by the U.S. National Cooperative Soil Survey consists of 10 file geodatabases covering the following areas: Conterminous states, Alaska, Hawaii, Puerto Rico and U.S. Virgin Islands, American Samoa, Federated Micronesia, Guam, Marshall Islands, Northern Mariana Islands, and Palau. Using ArcGIS Pro, the MUPOLYGON feature class in each of the 10 datasets was reprojected into the Web Mercator (auxiliary sphere) projection. The reprojected feature classes were then merged into one feature class using the Merge tool and stored in a file geodatabase. The tabular data in the *mapunit*, *component*, and *muaggatt* tables were merge as well. There are 1,112,331 components in the *component* table and 314,935 map units in the *mapunit* table. The three tables were exported as CSV files for further processing using the R programming environment.

Parsing the Data

Each individual map unit in the MUPOLYGON spatial data corresponds to one line in the *mapunit* table, and each line in the *mapunit* table corresponds to one or more lines in the *component* table since map units can have multiple components. Components consist of named soil series and often various not-soil categories such as urban land, pits, rock land, water, etc.

Creating a map of a soil property, for example, the presence or absence of natric horizons and sodic properties, is a multistep process.

First, for each component in the *component* table, we determine if the component contains the property of interest and flag the component, yes or no, accordingly.

Second, for each map unit, we calculate the fraction of the area of the map unit that contains the property of interest and then divide by the fraction of the map unit that contains soils with valid taxonomic classifications. Most map units consist entirely of classified soils, but some map units, for example those in urban areas or mountainous areas, contain significant areas of not-soil such as urban land and rock outcrops. Normalizing by the total area of the classified soils fills in map units that are predominately not-soil so long as they have at least one component that is a classified soil.

Third, decisions must be made as to the composition of the map units on the *new* map. After several draft maps and input from external several reviewers, we settled on the following classes with respect to the fraction of the area of the map unit that contains the property of interest: (a) 50 - 100%, (b) 10 – 49%, and 1 – 9%. The break at 10% corresponds to the break commonly used for determining whether a limiting, very contrasting component is included in a map unit name. The three classes are sufficient to reveal the most important relations without making the maps overly complicated.

Fourth, if several properties are included on the same map, additional decisions must be made as to which properties take precedence.

Finally, the mapunit table is joined to the spatial data and a draft map is prepared. Selection of colors for the different map units requires additional consideration and adjustments to make a pleasing, informative map for display on top of a hillshade. Ideally, the colors should be colorblind safe.

A Sodic Soils Map

A Sodic Soils map (below) was prepared using the procedure described in the left panel. The map can be examined in detail using the Soil Explorer app for iPhone/iPad (Apple App Store) or Android devices (Google Play) or using SoilExplorer.net. (Choose the Conterminous US region and then the Sodic Soils map.) This map shows all map units that have any fraction of soils with sodic properties in the conterminous US, Puerto Rico, and the US Virgin Islands. Comments are welcome, particularly with respect to how prominently areas of <10% of sodic properties should be highlighted visually, if at all.
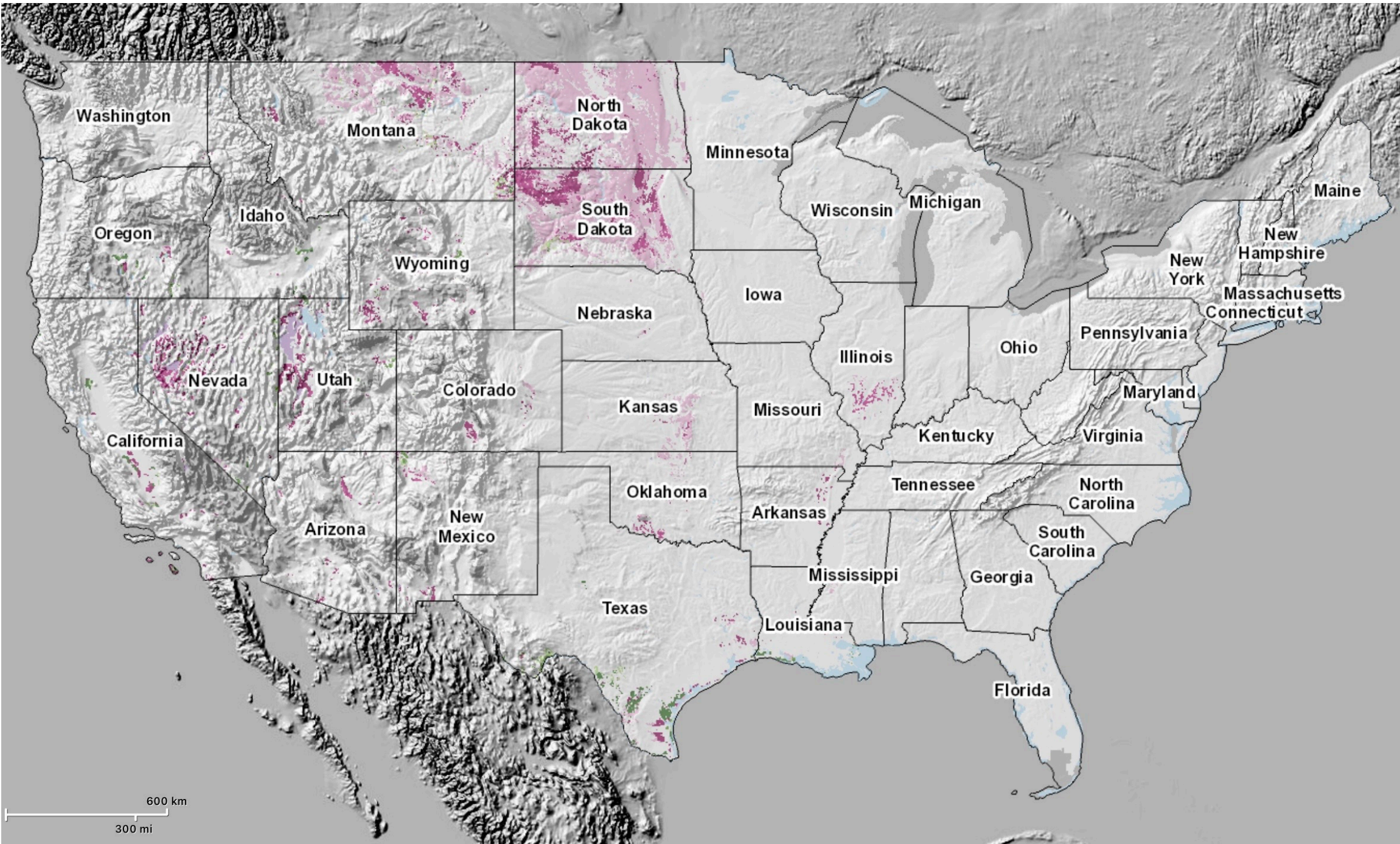

Draft Maps Under Development

Several additional maps are currently in process. Some are shown here as initial concepts. Comments and thoughts are welcome.

Argillic – Kandic – Natric Horizons

Pedogenic enrichment of clay in the subsoil is one of the most common of soil properties as show by the draft map below of soils with argillic, kandic, and natric horizons. A threshold of ≥10% of the map unit area was used for argillic and kandic horizons and a threshold of ≥1 % was used for natric horizons. There are mistakes in the distribution of natric horizons that are corrected on the Sodic Soils map above.
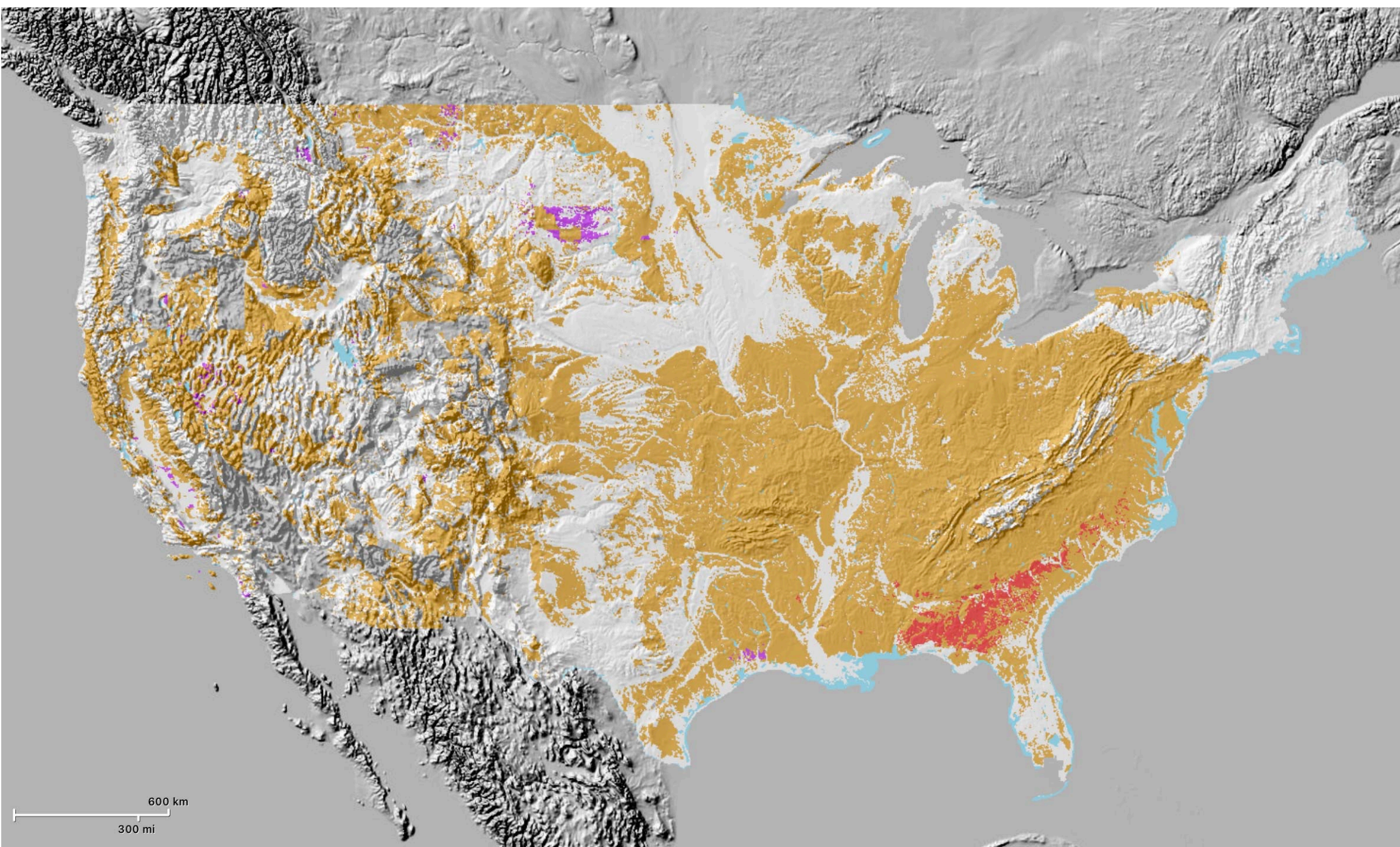

Explore These Draft Maps in More Detail

These draft maps can be explored in detail using Soil Explorer. The drafts are hidden in plain site. In the *Select a Region* pick list, scroll to the bottom of the list and select the bottom line marked only by a dash (-).
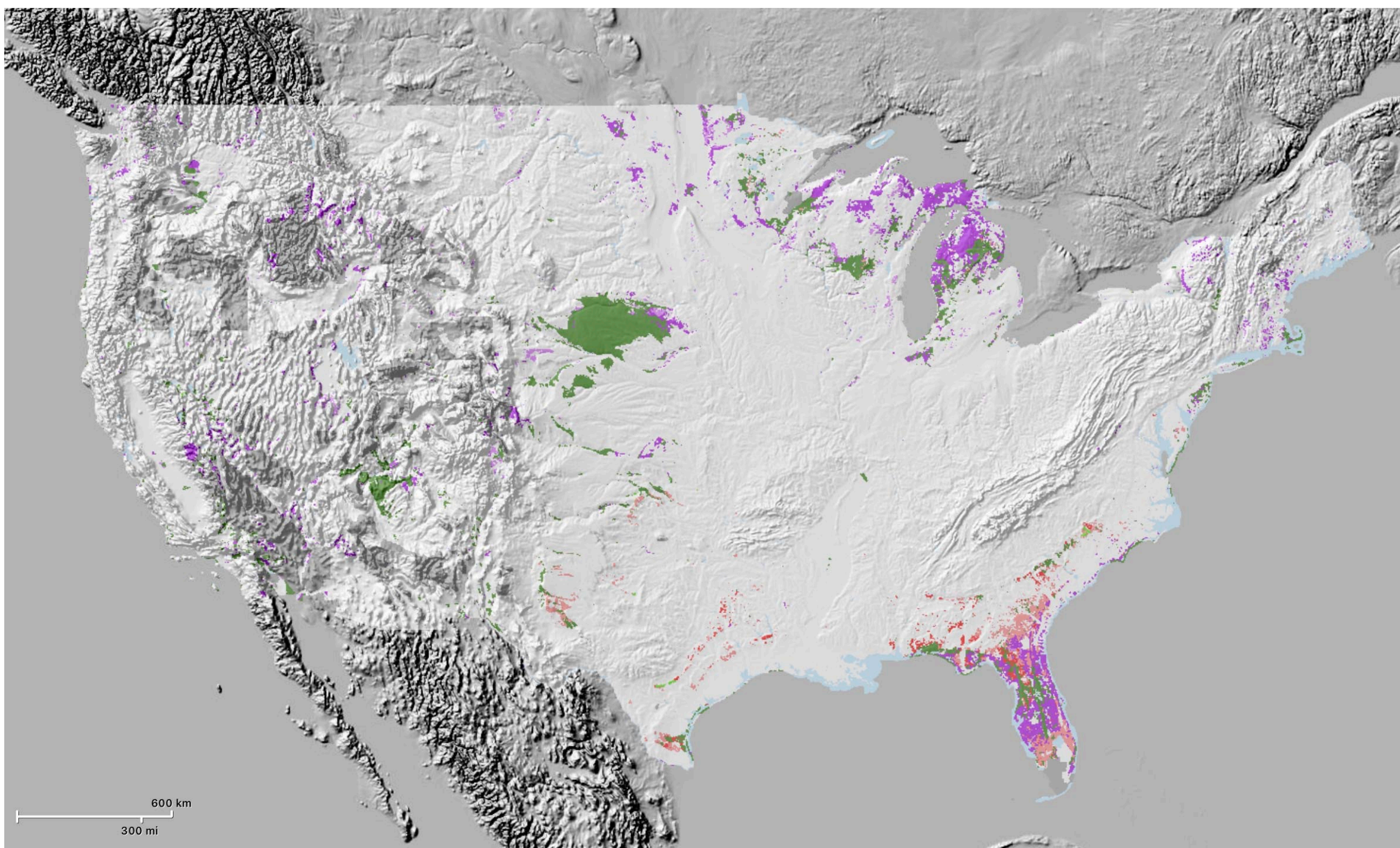
Duric – Calcic – Gypsic – Salic Horizons

The draft map below shows the distribution of horizons that occur in progressively drier climates west of the Mississippi River. Soils with calcic (pink), petrocalcic (red), gypsic (light purple), petrogypsic (dark purple), and salic horizons (green) are shown in individual classes, while soils with duripans and durinods (dark blue) are combined in one class for now, but will be separated in a future version. A threshold of ≥10% of the area of the map unit was used in all cases on this map.
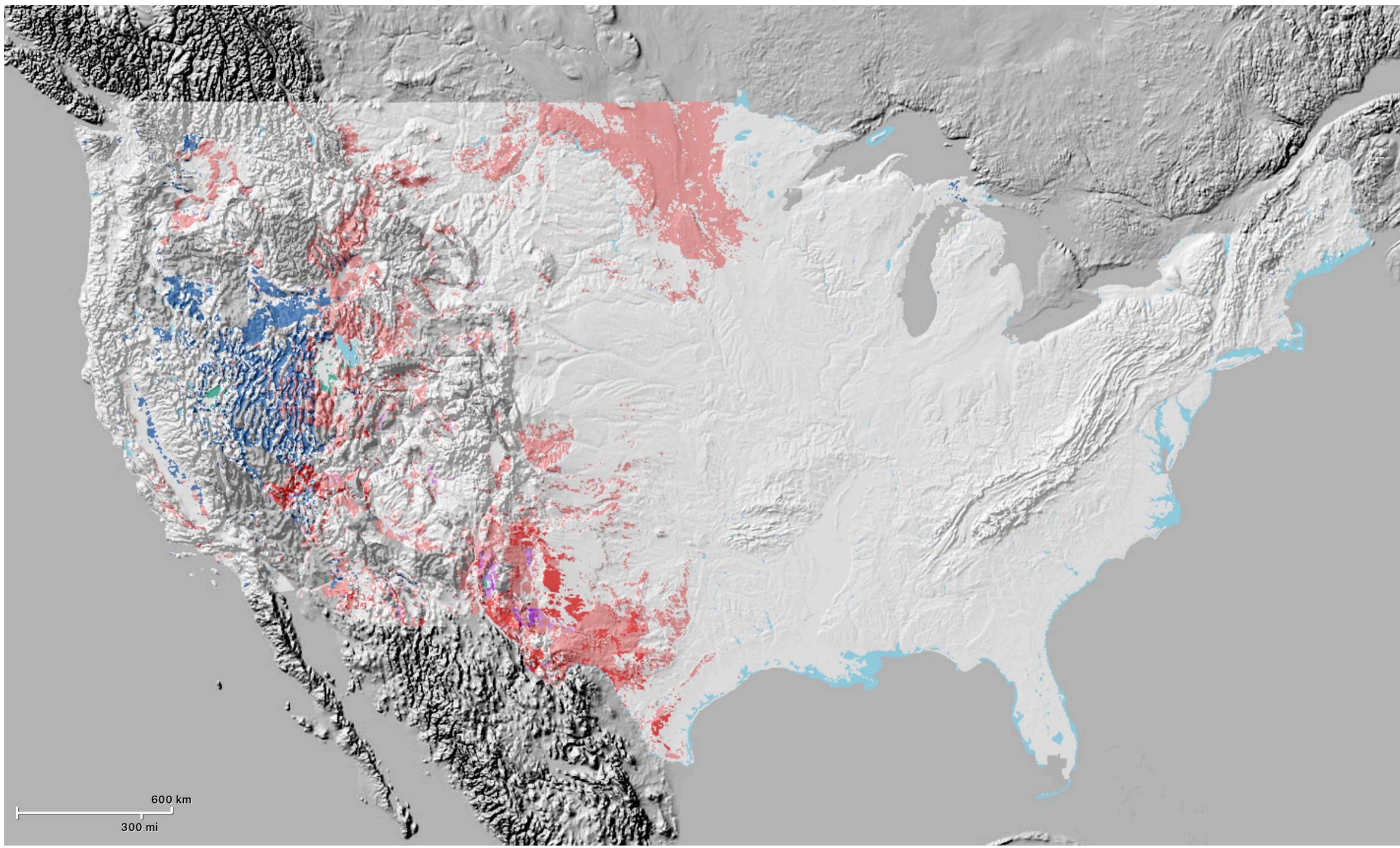
Deep Sandy Soils

This draft map shows soils with sandy horizons or layers >50 cm deep. *Sandy* includes the texture classes of coarse sand, sand, fine sand, loamy coarse sand, loamy sand, or loamy fine sand. The categories on this map are: Psamments (dark green), psammentic subgroups (light green), arenic subgroups (pink), grossarenic subgroups (red), sandy particle size families (purple), and soils with sandy strata within the control section (light purple).

This map shows only the most abundant component, not the dominant condition as the previous two maps. Still, broad trends stand out. Florida is obvious as the state with the largest area of deep sandy soils.

Acknowledgements